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THE EFFECTS OF PARALLAX SCROLLING ON USER EXPERIENCE AND
PREFERENCE IN WEB DESIGN

A Thesis

Submitted to the Faculty

of

Purdue University

by

Dede Frederick

In Partial Fulfillment of the

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of

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ABSTRACT

Frederick, Dede M. M.S., Purdue University, May 2013. The effects of parallax scrolling on user experience and preference in web design. Major Professor: Dr. James Mohler.

Parallax scrolling is becoming an increasingly popular strategy in web design. In addition to its ability to engage users with a website, advocates of the technique argue that it also improves the overall user experience. This study was therefore conducted to investigate whether parallax scrolling can support these claims.

Researchers have attributed a pleasurable user experience to the fulfillment of the following variables: usability, satisfaction, enjoyment, fun and visual appeal. The goal of this study was to establish whether or not parallax scrolling can influence these variables and subsequently the user experience.

Eighty six individuals were randomly selected and assigned to one of two experimental groups. Participants from each group completed three tasks on one of two websites, which were identical in all respects except for scrolling effects. While group 1 interacted with a website utilizing the parallax scrolling effect, group 2 saw a website not using the effect. All participants completed a survey after completing their tasks.

A Mann-Whitney test was performed to compare participants' survey responses with respect to the five measured variables. However, it failed to return any significant differences between the groups, except for 'fun' and professional design of the website. Participants believed that the website utilizing parallax scrolling was significantly more

fun and looked more professionally designed. Overall parallax scrolling did not significantly improve overall user experience; however it did enhance certain aspects of the user experience.

CHAPTER 1. INTRODUCTION

How do we influence product preference or a consumer's experience with a product or website? In the early days of the internet and web design, attention was particularly placed on website usability, and most research focused on elements such as font size, ease of use, button size and so on. Today however, the emphasis on user centered design has shifted the focus from the functionality and pragmatic qualities of a product to the emotional experience derived when interacting with that product. This experience is considered an essential element for the success of any product or information system.

In consideration of this, many marketers are utilizing the design of their products to distance themselves from their competitors and gain an advantage in the marketplace (Cox & Cox, 2002; Cruesen & Schoormans, 2005). Product designers are continually seeking to improve the visual appeal and subsequently the hedonic qualities of their products all in an effort to influence consumer preference and experience. Research has shown that visual appeal is highly correlated with the user's emotions and feelings (Desmet & Hekkert, 2007; Lindgaard, 2007; Norman, 2003); moreover these emotions determine the user experience (Hassenzahl, 2004, 2007; Lavie & Tractinsky, 2004; Mahlke & Thüning). Visual appeal can directly and indirectly influence the user experience.

Another important design factor considered in this study is novelty. Veryzer and Hutchinson (1998) argued that novelty not only affects product attractiveness, it also affects users' emotions by creating positive responses. Novelty has been shown to be very influential in product marketing, which is attributed to our desire for pleasure (Baumgartner & Steenkamp, 1996; Biederman & Vessel, 2006). This study examines the influence of a relatively novel design (parallax scrolling) in web design. It investigates the effects of parallax scrolling on user experience and product preference.

1.1 Scope of Research

Over the years website design has transformed in proportion to users' expectations. No longer are users satisfied with simply surfing a website to find information or accomplish a particular task; they expect to enjoy the experience while doing so. This pleasurable experience has been shown to be strongly linked with the visual appeal of a website (Hassenzahl & Tractinsky, 2006; Jordan, 1998). Moreover novelty has been shown to increase visual appeal and consequently user experience (Brave & Nass, 2003; Veryzer & Hutchinson, 1998).

In view of the previous information, this study examines how website novelty affects user experience. This study investigates how parallax scrolling within a website can affect user experience and consequently user preference.

1.2 Significance of Problem

Historically most research has been focused on website usability. Such research focused on design aspects such as font size, font type, word density, size of input boxes,

button sizes and so on. This was very useful because it ensured that users were able to use the websites efficiently and achieve their goals. However recent research has revealed that visual appeal also influences users' perception of a website (Hassenzahl, 2001; Jordan, 1999; Karapanos, Martens, & Hassenzahl, 2009). In fact visual appeal actually affects perceived usability (Papachristos & Avouris, 2011). On the other hand, other studies have shown that usability and aesthetics are equally important in design, and whether one or the other is dominant in the interaction depends on the users goals (Hassenzahl, Kekez, & Burmester, 2002). Nevertheless there are other studies that argue that visual appeal is dominant even when the task to be performed is highly practical (Schrepp, Held, & Laugwitz, 2006). Yamamoto and Lambert (1994) showed that even in industrial products, visual appeal is favored above price and performance.

Based on these results, more aesthetically pleasing websites have a greater chance of attracting visitors. In areas such as e-commerce and online retailing this could mean the difference between a successful website or business and one that is not. Li and Yeh (2010) showed that website aesthetics can influence customers' trust in e-commerce websites and subsequently their purchase intentions. Website owners, irrespective of their niche, are continually seeking ways to turn website visitors into loyal clients. Due to its visual appeal and saliency (Loken & Ward, 1990), novelty has been regarded as a means of capturing users' attention and loyalty (Woll & Graesser, 1982). Marketers are now utilizing novelty in their product designs to help differentiate themselves from the competition (Cox & Cox, 2002; Cruesen & Schoormans, 2005).

According to Brave and Nass (2003) novelty can have a significant impact on the user's emotional experience. Lindgaard and Dudek (2002) also demonstrated that a

pleasant experience is connected with the emotions and will create user satisfaction.

Garrett (2006) asserts that this positive user experience builds customer loyalty.

How can one improve user experience and consequently customers' preference for a website? How does a website owner increase the chances that website visitors experience pleasant emotions when interacting with their website? How does one improve user satisfaction? The objective in this study is to investigate how a relatively novel website design technique (parallax scrolling) can affect the user experience.

1.3 Statement of Purpose

In the early days of website design people were content with just being able to surf the internet to browse the relatively few websites that were available. Many of the usability problems that they experienced were thought to be part of the process. As the internet and website design evolved, designers and researchers focused on the improvement of website usability in an effort to make it easier for users to achieve their goals. Today with our advances in technology, research has revealed that usability alone is inadequate to create an enjoyable user experience.

Veryzer and Hutchinson (1998) found that there was a correlation between visual appeal and user experience; however this relationship is curvilinear (Blijlevens, Carbon, Mugge, & Schoormans, 2011; Hung & Chen, 2012; Mandler, 1982). Berlyne (1974) also demonstrated a curvilinear relationship between novelty and preference. Lindgaard and Dudek (2002) showed that a pleasant experience is connected with the emotions, which in fact determines the user experience. Li and Yeh (2010) found that visual appeal had a strong influence on customer trust in e-commerce websites. This is important because a

high level of trust is a necessary component for customer purchases and retention (Siau & Shen, 2003). This research seeks to investigate the relationship between novelty, particularly parallax scrolling and user experience.

1.4 Research Question

The research questions in this study included:

1. Can parallax scrolling in website design improve user experience and consequently user satisfaction?
2. Do users show more preference for websites with greater novelty than simple and more typical websites?

1.5 Assumptions

The following assumptions were associated with this study:

1. Participants responded honestly to the survey
2. The sample was random and the participants were representative of the population
3. The results of the study can be generalized to the wider population
4. The statistical techniques selected were appropriate for analysis of the data
5. The sample size was large enough to allow the researcher to detect significant differences in the population.
6. The survey was reliable and the scales were actually measuring the dependent variables

1.6 Delimitations

Delimitations of the study:

1. Participants are required to be regular internet users
2. Only one aspect of website design (scrolling technique) will be investigated

1.7 Limitations

Limitations of the study:

1. The study was limited to students from Purdue University, which may not have been truly representative of the population
2. The results of this research was based on participants' subjective responses
3. Participants completed the experiment in an open area and could have been distracted during the experiment
4. Participants completed the experiments at different periods of time and consequently environmental conditions may not have been equal for everybody
5. Although all experiments were completed using the same web browser, participants completed the experiment on two workstations which differed in physical specifications

1.8 Definitions

expressive aesthetics- this refers to the “design attributes of a website or product which stresses on originality, novelty, special effects or the designers’ creativity” (Lavie & Tractinsky, 2004, p. 280).

classical aesthetics- “refers to design attributes of a website such as the organization of the website, clearness, cleanness of the website and symmetrical design of the website” (Lavie & Tractinsky, 2004, p. 280).

usability - the extent to which a product allows a user to effectively utilize it, in respect to its intended purpose with ease and satisfaction (ISO 9241-11, 1998).

user experience -the reactions (emotional or psychological) that an individual experiences through an interaction with a product or service (ISO FDIS 9241-210 , 2009).

novelty- an individuals’ perceived newness of a product based on his/her comparison of the current form of that product with forms of past experience (Fiore & Kimle, 2010, p. 381).

1.9 Summary

The purpose of this chapter was to provide an overview of the research project. Here the researcher gave a statement of the problem and the significance of undertaking research to solve this problem. The researcher defined his research question, and highlighted his assumptions, limitations, and delimitations. The section concluded with a definition of the key terms.

CHAPTER 2. LITERATURE REVIEW

Over the past few years, the field of HCI has seen a shift of focus from product utility to the affective experience users have when interacting with a product. This relationship, which has been dubbed ‘user experience’, has evolved into a core principle of design and product development. Proponents of user experience regard it essential for the success of any product (Kujala, Roto, Väänänen-Vainio-Mattila, Karapanos, & Sinnelä, 2011). Garrett (2006) proposed user experience as an instrument for creating customer loyalty and thus should be the objective of every product. Taking this into account, marketers are going to great lengths in the design of their products to ensure a pleasurable user experience. Yet in spite of its growing popularity in the HCI domain, a common definition for user experience is yet to be accepted.

According to Hassenzahl and Tractinsky (2006) the word user experience has several different meanings, which include usability, aesthetics, hedonic qualities, and the overall experience one has using a product. Hassenzahl (2005) perceives user experience as “encompassing all aspects of interacting with a product” (p.41). The ISO (2008) defines user experience as the reactions (emotional or psychological) that an individual experiences through an interaction with a product or service (ISO FDIS 9241-210, 2009). Finally, Garrett (2006) defines it as “the subjective perception of a particular moment in time” (p. 36) and therefore is very subjective. Hassenzahl and Tractinsky (2006) relate

user experience to emotions such as fun, happiness, beauty, pleasure, enjoyment and pride that may emerge in a human-product relationship. In light of the previous definitions, we will consider user experience as the emotions that are aroused in an interaction with a product or technology.

2.1 Influence of Usability on User Experience

Historically website usability was regarded as the means for attracting and keeping visitors, but research in user centered design has revealed that pragmatic qualities alone cannot create the user experience that will influence customers' preferences. However this by no means excludes the influence of usability from the design process or the user experience. The ISO (1998) defined usability as the degree to which a user can effectively utilize a product, in respect to its intended purpose with ease and satisfaction (ISO 9241-11, 1998). Usability is associated with the effectiveness, efficiency and satisfaction of a product or website. Hassenzahl (2001) defines usability as the 'quality of use' which also refers to its efficiency and effectiveness. Effectiveness is the capability of a product to produce a desired result; efficiency is the minimum effort required for the product to accomplish a desired goal; and satisfaction is the user's level of acceptance and contentment with the product (Hassenzahl, 2001).

Although an essential aspect of product development, Jordan (1999) argues that usability is limited because it is task oriented. From a usability viewpoint a product is just a tool to complete a task, when in reality a product is a "living object with which people have relationships. Objects can cause the user to feel happy, angry, proud, ashamed,

secure or anxious” (Jordan, 1999, p. 208). Hassenzahl (2001) argues that usability neglects fun and enjoyment and their influence on user satisfaction and preference.

Tractinsky et al. (2000) identified two major components in a user’s interaction with a product; usability and aesthetics. Both factors seem to influence the overall user experience; however the extent to which each feature affects the user experience is highly inconsistent among researchers. It might be inferred from these studies that the extent to which one is preferred over the other is dependent on the user’s intention to use the system, whether it is for hedonic or utilitarian purposes. Hassenzahl, Kekez, and Burmester (2002) conducted a study that showed a positive relationship between visual appeal and usability when participants were asked to complete tasks on a website; however the relationship vanished when participants were asked to “just have fun”.

In a recent study Karapanos, Martens and Hassenzahl (2009) found that usability has a dominant influence on the user experience, but only in the initial interaction with a product. Their research showed that as the relationship between the user and the product developed; the hedonic qualities of a product became more significant, thus shaping the overall user experience. In light of this fact a number of studies are emerging, which suggests studying user experience over an extended time frame rather than the brief period of a typical research study (Kujala, Roto, Väänänen-Vainio-Mattila, & Sinnelä, 2011). This gives the researcher a more accurate analysis of the true determinants of user experience, considering that such elements change over time.

2.2 Aesthetics and the user experience

Mahlke and Thüning (2007) identified three components of user experience: instrumental, non-instrumental and emotion. Instrumental qualities refer to the system's usability while non-instrumental qualities refer to its visual appeal. The authors argue that both instrumental and non-instrumental qualities affect the user's emotions and consequently the user experience. Today, interactive systems are no longer designed to be just usable, they also need to be aesthetically appealing. This is supported by Hassenzahl (2004) who considers visual appeal as a requirement for product preference and loyalty.

Despite its widespread support in design, visual appeal does not offer any cognitive benefits to product usage. "The purpose of visual appeal in design is not to allow users to complete their task quicker, but to provide enjoyment, pleasure and fulfillment when doing so" (Vyas, Heylen, Eliens & Nijholt 2007, p. 2). Lavie and Tractinsky (2004) view the role of aesthetics as "satisfying the human requirements." They argue that "visual appeal can make products more acceptable thus increasing their commercial value" (p. 275). Hassenzahl (2005) argues that visual appeal offers emotional benefits by "emphasizing the individuals' psychological well-being" (p. 35), thus consistent with the view that aesthetics performs the function of satisfying the human requirements. Lindgaard et al. (2006) found that users are more forgiving of usability problems in websites which are visually appealing.

Research shows visual appeal to be strongly linked to hedonic feelings (Lindgaard, 2007; Desmet & Hekkert, 2007). Hassenzahl (2002) found visual appeal to be more highly correlated with the hedonic attributes of a product than with pragmatic attributes. By hedonic attributes we mean the pleasurable emotions that are derived in an interaction

with a product or system. Norman (2003) argues that attractive things create pleasurable emotions by “making people feel good, relaxed, happy and in a pleasant mood” (p. 26). Influencing users’ emotions through visual appeal is important to product design because as Kahneman (1991) shows, customers’ decisions are influenced by their emotions. Schrepp, Held, and Laugwitz (2006) also conducted a study that showed that hedonic qualities have a greater influence on people’s preference for business management software than pragmatic qualities. Taking this one step further Li and Yeh (2010) demonstrated that website aesthetics can also influence customers’ trust in e-commerce websites. In essence, although it offers neither cognitive nor pragmatic qualities, aesthetics play a pivotal role in shaping the user experience because of its effects on the emotions.

2.3 Emotions and the user experience

Isen (1994) demonstrated that positive affect promoted efficient cognitive organization and creative thinking. In one study, participants who were exposed to variables that stimulated positive emotions showed more creativity and performed significantly better at problem solving tasks than those who were not. Applying this concept to design, Norman (2003) argues that visually appealing products creates positive affect in users, which make them more creative. Therefore when a user encounters a problem with a product or interactive system, rather than being solely fixed on the problem at hand, these happy emotions helps the user to think of more innovative methods of solving the problem. Thus, rather than attempting to repeat the same

operation repeatedly, the user avoids frustration by finding an alternative solution to the problem.

Norman (2003) argues that life would be incomplete without emotions, and certainly user experience would be impossible without it. Jordan (1999) argues that products should be designed to create pleasure because as humans “we always have and will always seek pleasure” (p. 206). As discovered earlier, this pleasure is produced through the aesthetic appeal of a product (Desmet & Hekkert, 2007; Lindgaard, 2007; Norman, 2003). Hasseszahel (2004) describes the hedonic qualities of a product as having the ability to stimulate the user and fostering identification. Stimulation is achieved through novelty and aesthetics whereas “identification allows the user to express himself or herself through the product and communicates important personal values to relevant others” (p. 322).

2.4 Novelty and aesthetic response

Emotions are strongly influenced by aesthetics. However research has also shown aesthetics to be strongly correlated with novelty and in fact partly influenced by novelty. Novelty can be defined as “the perceived newness of the units and their organization, based on comparison of the present form with forms of past experience” (Fiore & Kimle, 2010, p. 381). According to Hekkert and Leder (2008), “based on our knowledge and previous experiences, we qualify something as familiar or novel, typical or strange, original or outdated” (p. 266). Novelty affects product attractiveness and creates a positive response in individuals (Veryzer & Hutchinson, 1998).

As human beings we take pleasure in acquiring new information and interacting with unfamiliar objects and therefore people are always searching for novel product designs (Baumgartner & Steenkamp, 1996; Biederman & Vessel, 2006). This behavior can also be explained by the human need for pleasure. Since novelty is correlated with visual appeal, we may always seek novelty in design because it looks more attractive and this appeal creates pleasure. As Desmet & Hekkert (2007) stated, because aesthetics influences pleasure “we are motivated to seek products that provide pleasure and avoid products that provide displeasure” (p. 62).

However the relationship between novelty and aesthetics is curvilinear. Although newer products are rated higher on visual appeal than typical product designs, aesthetic appeal is significantly decreased if the design deviates significantly from the typical. Moderately novel products were considered more aesthetically pleasing than extremely novel designs. The further a product deviates from the typical, the more difficult it becomes for the brain to fit it into existing knowledge and consequently that decreases its aesthetic appeal (Mandler, 1982). The solution is a balance between novelty and typicality; it is balance that produces high levels of pleasure and increases the user experience. (Hekkert & Leder, 2008).

This behavior can be explained with Berlyne’s hypothesis that there is an inverted-U curve between novelty and preference. According to this theory, an individual has preference for novel products, but only when the novelty is at a moderate level. If the design is excessively unusual, it is perceived to be less appealing (Berlyne, 1974). Hung and Chen (2009) demonstrated a similar behavior by presenting participants with a variety of chair designs. Highly typical and novel chair designs were rated lower in

aesthetics and appearance while those designs which received the highest scores were those with medium novelty. The results of their study confirmed an inverted-U function between preference and typicality. This extends beyond just users' perception of aesthetics. Mugge and Schoormans (2012) found that there was a negative correlation between products with a high degree of novelty and customer expectations. People perceive the usability of a product based on its level of novelty. This is especially true for less experienced users. The higher the level of novelty, the lower its perceived usability and the lower its aesthetic appeal.

2.5 Why focus on novelty in design

Novelty can be utilized as a powerful tool in product design and marketing. It has a significant impact on the user's emotional experience (Brave & Nass, 2003), "creates curiosity and encourages exploration" (Lazzaro, 2003, p. 696). Novelty has a high aesthetic appeal and has the ability to attract attention (Hekkert, Snelders, & Van Wieringen, 2003). In their study of consumer responses to product novelty, Radford and Bloch (2011) found that people exhibited more positive responses to novel products. Due to its visual appeal, novelty in design can be used as a tool to help marketers differentiate themselves from the competition and gain an advantage in the marketplace. (Cox & Cox, 2002; Cruesen & Schoormans, 2005). Designers are constantly exploiting this relationship to create novel designs that appeal to consumers (Hung & Chen, 2012).

According to Woll and Graesser (1982), innovative products catch attention and are better remembered. An explanation may be that consumers view newer or non-typical products as having higher saliency when compared to other products (Loken & Ward,

1990). Products are remembered in two ways: they are typical and encountered frequently or they are atypical and therefore grab attention. For an e-commerce website competing with hundreds of other websites selling similar products, novelty offers far greater advantages. It takes the average internet user about 50 milliseconds to make a first impression of a website and decide whether to continue or move on to another webpage (Lindgaard, Fernandes, Dudek & Brown, 2006). The number of websites that the average internet user encounters every day is numerous and it is highly improbable that one particular website will be encountered enough to be remembered. In such situations novelty is the tool which sets one website apart from the competition.

As human beings, we have an innate preference for novelty. We take pleasure in acquiring new information and interacting with unfamiliar objects (Biederman & Vessel, 2006). As a result, people are always searching for novel product designs. Holbrook and Hirschman (1982) attribute this attraction to novelty as the individual's need for variety. We can observe this behavior when we see people standing hours in line to buy the newest version of iPhone, iPad or one of the high end Android smart phones. Baumgartner and Steenkamp (1996) demonstrated this in their research by presenting participants a succession of images. They observed that preference for images declined with each repetition.

2.6 Novelty and user experience

What is the role of novelty in the user experience? Using deductive reasoning, one can argue that since visual appeal influences the emotions and novelty affects visual appeal, it could be said that novelty affects the user experience. In fact Brave and Nass

(2003) sees novelty to have a significant impact on the emotional experience. Novelty affects product attractiveness and creates a positive response in individuals (Veryzer & Hutchinson, 1998). In their study of consumer responses to product novelty, Radford and Bloch (2011) found that people exhibited more positive responses to novel products. Berlyne (1974) attributes people's positive reactions to novelty because it creates pleasure. When an individual interacts with a novel design, it creates pleasure and that in turn positively influences the user experience.

A number of researchers have demonstrated a relationship between novelty and aesthetic appeal (Blijlevens et al., 2011; Hung & Chen, 2012; Mandler, 1982; Mugge, & Schoormans, 2011). It has also been demonstrated that high levels of visual appeal creates positive emotions (Hassenzahl & Tractinsky, 2006; Jordan, 1998; Norman, 2003; Tractinsky, 1997). Norman (2003) argues that attractive things create pleasurable emotions by “making people feel good, relaxed, happy and in a pleasant mood” (p. 26). According to Biederman and Vessel (2006), humans take pleasure in acquiring new information and interacting with unfamiliar objects. As an individual interacts with a new unfamiliar product, the enjoyment of the activity creates a pleasant mood which allows him to overlook and forgive its faults and usability problems, thereby ensuring that he enjoys the experience. Novelty in design is really designing for the emotions and as stated by Sears and Jacko (2007) “emotional design seeks to make interactive products not only more efficient but also more pleasant” (p. 1285).

2.7 Parallax scrolling and user experience

Parallax scrolling has become a very popular technique in web design over the past few years. At the time of this writing, a quick search on Google for the term “parallax scrolling” will yield multiple pages showing websites currently exploiting this technique to enhance the appearance and interactivity of their website and engage their visitors. The parallax scrolling effect allows multiple backgrounds in a webpage to move simultaneously at different speeds to create a 3D perception, thus enriching the browsing experience. In addition to its aesthetic appeal, parallax scrolling offers web designs an opportunity to directly draw the users’ attention and guide them to their products or ‘call to actions’. For example designers can create stories that can be revealed to users while scrolling down the webpage or in other cases, show users the functionality of a product in animated fashion. Many web designers acclaim parallax scrolling as a tool suited for enhancing the user experience, but due to its performance others argue otherwise.

Research shows that it generally takes a user 50 milliseconds to develop an impression of a website and decide whether he or she likes it (Lindgaard, Fernandes, Dudek, & Brown, 2006). However, in order for the parallax scrolling effect to work, all page elements and files must be loaded from the server unto the webpage before the user can start viewing the webpage. Compared to a typical website where a few images and elements are loaded to a webpage, all elements are loaded to a single webpage in parallax scrolling. Depending on the size and number of page elements, the page loading can last from a few seconds to over a minute. Depending on the user’s intention to use the website, this can determine whether he/she continues on the webpage or navigate to a new website. Although a relationship was discovered between usability and aesthetics

when a website was used for utilitarian purposes, the research show a different outcome when the purposes of use is hedonic (Hassenzahl, Kekez, & Burmester, 2002). Taking into account the shortcomings of parallax scrolling, this research seeks to investigate how parallax scrolling can influence the user experience.

2.8 Summary

A genuine pleasurable user experience seems to be determined by several factors intertwined and working together. Among these, visual appeal seems to be very dominant, and this is particularly due to its hedonic attributes. Taking this into consideration, this research study seeks to examine parallax scrolling, a particularly visually appealing web design technique and how it affects the user experience. This design technique seem to possess the traits to create a pleasurable user experience, however it lacks good usability. In view of this limitation, this research seeks to investigate how parallax scrolling will influence user experience and preference.

CHAPTER 3. METHODOLOGY

3.1 Research Framework

Research has revealed that a pleasurable user experience can create loyalty and determine the success of a product or technology (Garrett, 2006). An enjoyable user experience creates pleasure and as human beings we always seem to gravitate towards pleasure while migrating away from displeasure (Jordan, 1999). The purpose of this research is to find how novelty in web design affects preference and user experience. In this study the author seek to investigate the effects of parallax scrolling on subjective user experience.

3.2 Hypotheses

This study seeks to investigate the effects of parallax scrolling on web design. Group 1 contains the website utilizing parallax scrolling and group 2 contains the website with no parallax scrolling. The following hypotheses will be tested:

H_O1: There are no significant differences in perceived usability between the two groups

H_A1: There are significant differences in perceived usability between the two groups

H_O2: There are no significant differences in perceived enjoyment between the two groups

H_A2: There are significant differences in perceived enjoyment between the two groups

H_O3: There are no significant differences in the fun user experience between the two groups

H_A3: There are significant differences in the fun user experience between the two groups

H_O4: There are no significant differences in user satisfaction between the two groups

H_A4: There are significant differences in user satisfaction between the two groups

H_O5: There are no significant differences in visual appeal between the two groups

H_A5: There are significant differences in visual appeal between the two groups

H_O6: There are no significant differences in overall user experience between the two groups

H_A6: There are significant differences in overall user experience between the two groups

H_O7: There are no significant differences in user preference between the two groups

H_A7: There are significant differences in user preference between the two groups

3.3 Population

Participants for this study were recruited from Stewart Center at Purdue University. The intercept method was used to recruit students as they walked through the

hallway of Stewart Center. Participants who opted to take part in the research experiment were offered a chance to enter in a raffle for three gift cards of \$20.00.

A sample size of 86 participants was used in the research experiment. This was consistent with previous research conducted in the field (Dudek, & Brown, 2006; Lindgaard, Fernandes, Hung & Chen, 2012; Sauer & Sonderegger, 2011). In keeping with other research (Al-Shamaileh & Sutcliffe, 2012; Lindgaard, Fernandes, Dudek, & Brown, 2006), a between group design was employed and participants were randomly assigned to one of two groups (43 in each condition).

3.4 Experiment Setup

The objective of this research experiment was to investigate how the independent variable (scrolling technique) affected the dependent variables (satisfaction, usability, enjoyment, visual appeal, and fun). These five variables have been shown to contribute to the overall user experience (Hassenzahl & Tractinsky, 2006; Norman, 2003). The researcher decided to utilize a between-subject research design where scrolling technique was manipulated at two levels. An advantage of the between-subject design is that it prevents any carry over effects such as fatigue, boredom or practice that can affect and skew the results of the study. Since each participant was exposed to only one of two treatments, participants' decisions were not affected by such extraneous factors (Gravetter & Forzano, 2011).

The control group in the experiment was assigned to work with the website not using parallax scrolling while the treatment group used the website employing the parallax scrolling technique. The parallax scrolling effect uses multiple backgrounds all

moving at different speeds to create a 3D perception, thus enriching the browsing experience. In order to limit the effects of other confounding variables, all other design elements in the websites were kept constant. The webpages in both experimental conditions looked exactly the same; with the only difference being the websites' technique of scrolling.

All webpages contained the same content, same fonts and font sizes, same color and design, similar symmetry, overall the same level of visual appeal and usability. All web pages were highly designed in classic aesthetics, but expressive aesthetics varied depending on the experimental condition. Expressive aesthetics refers to elements of the website such as creativity and originality (Wang, Minor, & Wei, 2011) and because the experimental condition varied in scrolling effect, expressive aesthetics was not equal for both conditions. For example although the websites for both groups were visually identical, one utilized parallax scrolling while the other did not. This effect is only noticed when the user starts interacting with the website. The parallax effect is an example of expressive aesthetics and inevitable could not be equal for both groups. Parallax scrolling is a novel control that was tested in this research experiment. By controls we mean a “manipulable, self-contained screen object through which the user interacts with the website” (Cooper, 2007, p. 439). Today, although many will consider page scrolling a necessary component of web design, there is debate on whether websites should continue scrolling or adopt paging. The purpose of this research was to make scrolling more fun and test whether it enhanced the user experience.

3.5 Procedure

Two hotel websites, identical in all respects apart from scrolling method were created by the author for use in this research experiment (see Figure 3.1). In order to test the websites in a real world environment, both websites were uploaded unto a server over the internet where participants accessed them. Two laptop computers with internet access were set up on a table in the lobby at the Stewart Center to conduct the experiment. (see Table 3.1 for the specifications of the computers).

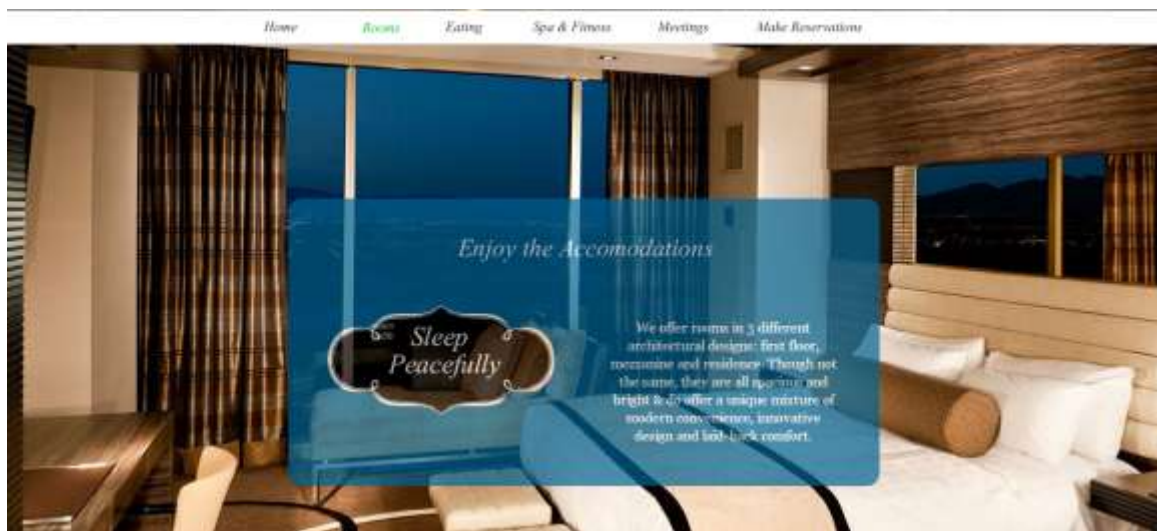


Figure 3.1

Figure of the hotel websites used in the experiment. Websites were identical to each other

Table 3.1

Specification for the computers used in the experiment

Computer specifications	Laptop 1	Laptop 2
Computer model	Asus K42JR	Dell Latitude E6500
Operating System	Windows 7 professional	Windows 7 professional
Processor	Intel core i5	Intel Core 2 Duo
Memory installed	6GB DDR3	4GB DDR2
Hard drive	320 GB	500 GB
Screen resolution	1366x768	1920x1200
Web browser used	Mozilla Firefox 19.0.2	Mozilla Firefox 19.0.2

Students were intercepted as they passed by and asked to participate in the experiment, which lasted no more than five minutes. Individuals who opted to participate in the experiment were randomly assigned to one of two experimental conditions.

Participants in each condition were presented with one version of the website.

Participants in condition 1 were presented with the website version utilizing the parallax scrolling effect while participants in group 2 interacted with the website without parallax scrolling. Prior to starting the experiment, participants were given a sheet containing the instructions to guide them through the experiment. Upon reading the instructions, participants navigated to a web address that was provided to them on the computer by directly clicking on the link or entering the provided URL in the address bar.

Participants were asked to spend between 30 seconds to a minute browsing the websites before they completed the two tasks. Upon browsing, participants from each experimental condition completed the tasks. The first task asked participants to complete a web form with their demographic information. Upon completion, participants were

presented with a notification that an error has occurred and were asked to repeat the process. This failed task was implemented to influence participants' emotional response. This allowed the researcher to measure whether user attitudes and experience for the two experimental conditions were significantly different. For the second task, participants were asked to make a reservation on the website. The order of the two tasks was randomized in order to reduce or eliminate any confounding variables not accounted for by the researcher. Each participant performed the experiment under the supervision of an instructor.

When the tasks were completed, participants answered a 'fifteen- item posttest survey to measure their overall experience with the website. All survey items were measured on a 6-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (6). This survey instrument can be found in Appendix C.

3.6 Instruments

The validation of the research instrument is an integral part of any research project because it accounts for the reliability of the results. If the instruments used in a study are not validated, the results of the study cannot be trusted. "Validated instruments allow researchers to measure the same research constructs in the same way, which results in improved measurements of the dependent and independent variables" (Straub, 1989, p. 148).

The researcher referenced two validation guidelines in the validation of the research instrument used in this study. These included face validity and content validity. Face validity is the easiest form of validation and can be determined by looking at the

instrument with respect to clarity and organization and deciding whether it looks valid (Lord, French, & Crow, 2009). This was determined by the researcher before distribution of the survey instrument. Content validity examines whether the questions included in the instrument are representative of the area of study (Li & Yeh, 2010). In observation of this guideline, the researcher opted to use items from previously validated studies in the following arrangements: usability (Flavián, Guinalíu, & Gurrea, 2006), enjoyment (Cyr, Head, & Ivanov, 2006; Van der Heijden, 2004), fun (Cyr, Head, & Ivanov, 2006; Van der Heijden, 2004), satisfaction (Cyr, Bonanni, Bowes, & Ilsever, 2005; Sauer & Sonderegger, 2011), and visual appeal (Cyr, Head, & Ivanov, 2006; Li, & Yeh, 2010). Survey questions were measured using a 6-point Likert scale and the subscales (subcategories) within the survey were randomized to prevent response biases. Cronbach's alpha was used to assess the reliability of scales and was measured against the reliability coefficient threshold of 0.6 as outlined in the literature (Hair, Anderson, Tatham, & Black, 1998; Nunnally, 1978).

3.7 Data Analysis

Data analysis was accomplished using the Statistical Package for Social Sciences (SPSS) software program. The experiment involved research participants responding to a questionnaire containing Likert scale items, which meant that analysis was performed on ranked data rather than numerical data. In order to adequately carry out this analysis, the Mann-Whitney non-parametric test was used to analysis the data. The Mann-Whitney test is the non-parametric equivalent of the independent samples t-test and was used to test the differences between the two experimental groups (Field & Hole, 2003). The Mann-

Whitney test was used because Likert scale items contain ordinal data rather than interval or ratio. In such instances parametric test methods cannot be used because of their strict assumptions.

3.8 Summary

The reliability of the results of a research project is dependent on the research framework. This chapter explains the overall design of this research project: hypothesis, variables, data analysis, instruments used, procedure, experimental set and the population sample. It gives the reader the opportunity to replicate the research if he/she so desires.

CHAPTER 4. RESULTS

The purpose of this research study was to analyze whether parallax scrolling, which has become a very popular strategy in web design can improve the user experience and preference of a website. In order to achieve this, the researcher designed two hotel websites which were identical in every respect except scrolling strategy and utilized a survey to analyze the differences in participants' responses between them. This analysis was achieved through three processes. The first process involved documentation of the participants' demographics to assess those who participated in the experiment. The second process involved running a reliability analysis on the survey instrument to analyze the reliability of the scales and the consistency of the items within those scales. Finally the Mann-Whitney test was used to test whether the differences that emerged between the groups were significant. This section provides a comprehensive overview of these processes.

4.1 Demographics of participants

The following section describes the demographics of the participants in this research. A total of 86 individuals participated in the research experiment and completely filled out the survey. The experiment was conducted at the Stewart Center at Purdue University which is a central location, thus providing an equal opportunity for students

from all majors to be included in the research experiment. The majority of participants were from the College of Engineering and Liberal Arts, respectively representing 20.9% and 18.6% of the total sample. Of the remaining participants 12.7% were from the College of Health and Human Sciences, followed by the College of Science (11.6 %), College of Agriculture (8.1 %), College of Technology (8.1 %), College of Pharmacy (5.8 %), College of Education (5.8 %), Krannert School of Management (4.6 %), and the last three individuals were not affiliated with any department at the school. Figure 4.1 gives a detailed breakdown of this information.

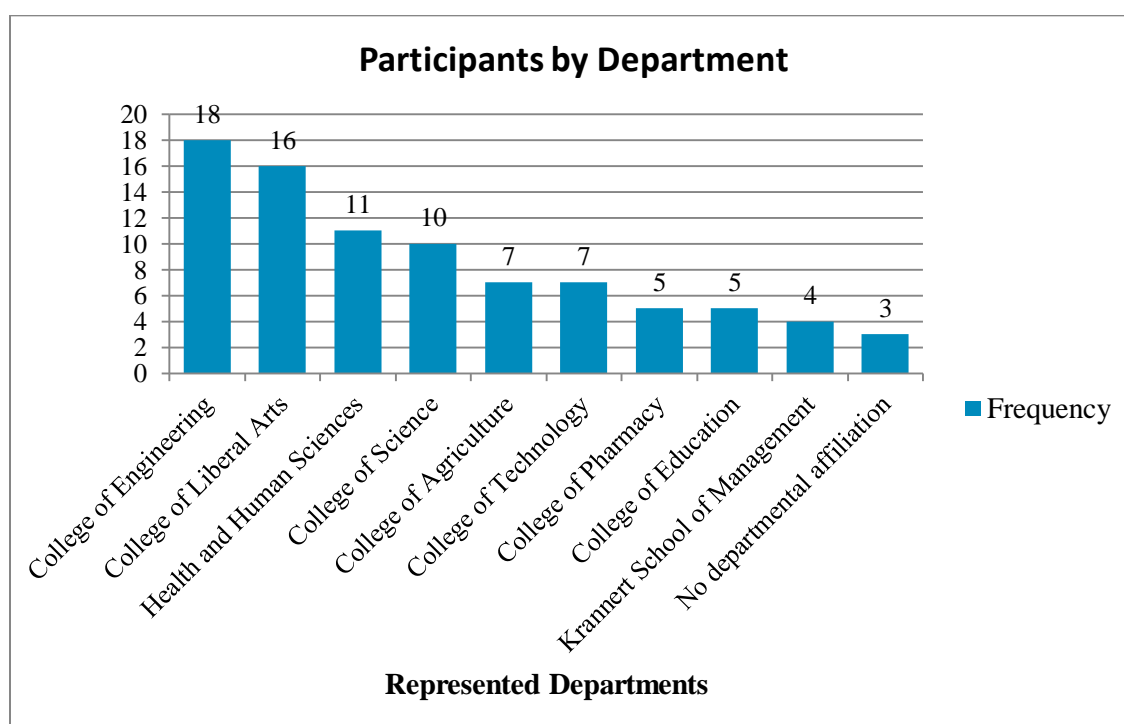


Figure 4.1. Research participants by department.

With respect to age, 65.1 % of participants were 21 years old or younger, 33.7% ranged between 22 and 34 years and the last participant was between 55 and 64 years of

age. Overall there were a total of 40 male and 46 female participants in this research study, majority being white (45.3 %). Of the remaining participants, (25.6 %) were black, (22.1 %) were Asian, (4.7 %) Latino and the last two participants were American Indian and Pacific Islander. Figure 4.2 gives the numeric representation of research participants by ethnicity.

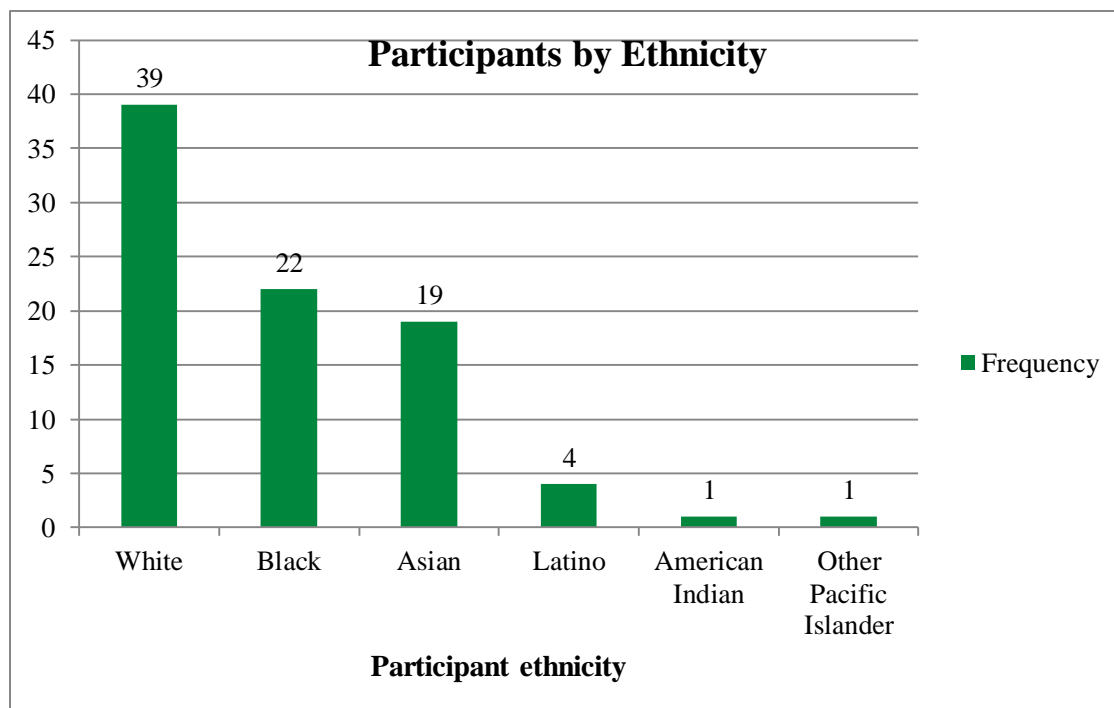


Figure 4.2. Research participants by ethnicity.

Seventy-one percent of participants were undergraduate students, 15.1% were graduate, while the other 5.8 % were non-students. Among the undergraduate participants, 26.5% were freshmen, 32.4% sophomores, 20.6 % juniors and 20.6% seniors. A detailed representation of participants in regards to academic status can be found in Figure 4.3 and Figure 4.4.

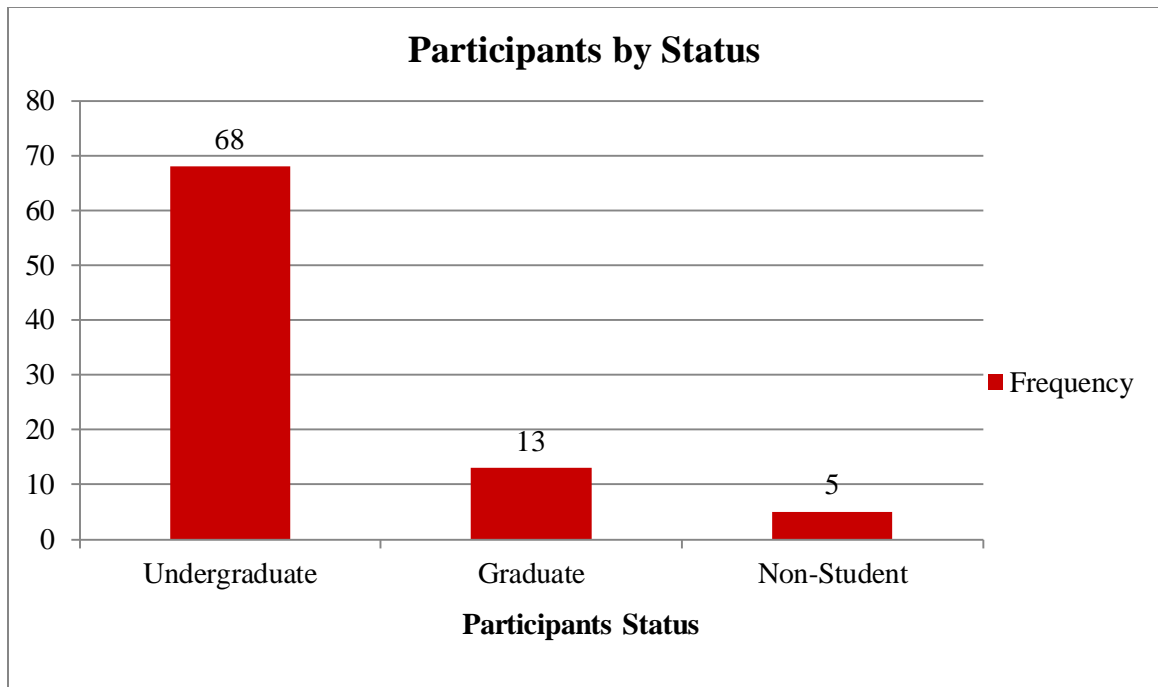


Figure 4.3. Participants by academic status.

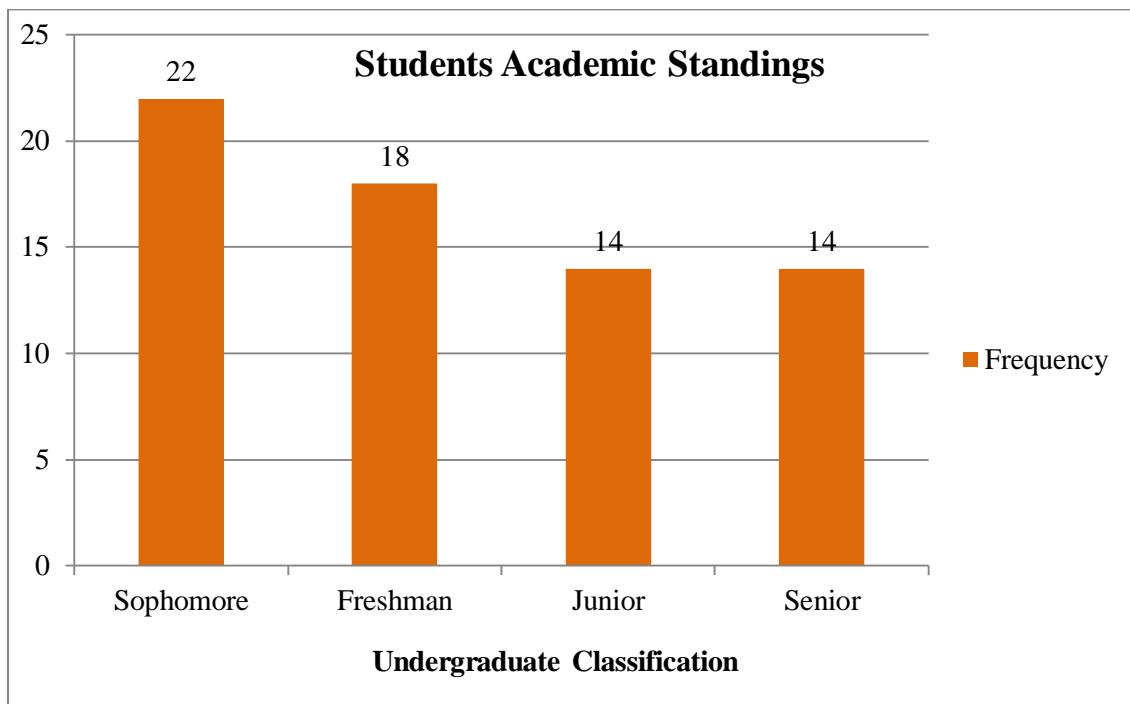


Figure 4.4. Students by classification.

4.2 Reliability analysis

Cronbach's Alpha was used to assess the reliability and internal consistency of the items in the scales. Each value was measured against the reliability coefficient threshold of $\alpha = 0.6$. The following are the results computed from the Cronbach's alpha for the items within each sub-category: usability, $\alpha = .806$; enjoyment, $\alpha = .947$; fun, $\alpha = .860$; satisfaction, $\alpha = .922$; visual appeal, $\alpha = .899$. The inter item correlation matrix also revealed consistently high correlations between the items within each scale; further validating the reliability of the survey instrument.

4.3 Analysis and hypotheses testing

It was assumed that parallax scrolling in web design would affect user experience and preference. As a result, seven hypotheses were formulated in support of this postulation. These hypotheses along with the data analysis in their support or rejection will be found in this section. The Mann-Whitney test was used to find differences in participant responses between the two groups on the five dependent variables: usability, enjoyment, fun, satisfaction, and visual appeal.

4.3.1 Usability

It was hypothesized that parallax scrolling would positively influence the perceived usability of the website. This was measured by the first three items of the survey instrument which can be found in table 4.1 below. The Mann-Whitney test failed to return any significant differences in participants' ratings with regard to these items.

Table 4.1

Items from survey instrument measuring website usability

Q1. This website is simple to use, even when using it for the first time

Q2. Downloading pages from this website is quick

Q3. The structure and contents of this website are easy to understand

Concerning Q1, participants thought that the website with no parallax scrolling ($Mdn=6$) was simpler to use than the website using the parallax scrolling effect ($Mdn=5$). From this point forward, ‘website 1’ or ‘group 1’ refers to the website utilizing the parallax scrolling strategy whilst ‘website 2’ or ‘group 2’ alludes to the website with no parallax scrolling. Website 2 also received a slightly higher mean rank score (mean rank: 44.85) than website 1 (mean rank: 42.15) suggesting that users responded a bit more favorably to website 2. This result however was not statistically significant, $U = 866.5$, $p=.58$, $r = -.06$. Participants from both groups believed the websites to load equally quickly, ($Mdn=5$), $U = 879.5$, $p=.68$, $r = -.04$. The mean rank for website 1 was 44.55 while website 2 had a mean rank of 42.45, but this difference is not significant considering that the effect size was tiny ($-.04$). With regard to the Q3, participants believed both websites were equally understandable, ($Mdn=6$), $U = 900.5$, $p=.82$, $r = -.03$. Table 4.3 confirms that overall user responses to the two websites were somewhat similar, considering that the mean rank differences between both groups was only 2. There was no evidence suggesting that website 1 significantly differed in usability from website 2. Therefore hypothesis 1 was rejected. For more detailed analysis, the Mann-Whitney test statistic is reported below in Table 4.2.

Table 4.2

Results of the Mann-Whitney test statistic with respect to Q1, Q2 and Q3

	Website is simple to use	Downloading pages is quick	Content is easy to understand
Mann-Whitney U	866.500	879.500	900.500
Wilcoxon W	1812.500	1825.500	1846.500
Z	-.550	-.418	-.230
Asymp. Sig. (2-tailed)	.583	.676	.818

a. Grouping variable: Group

Table 4.3

Mean rank scores for groups 1 and 2. The group with the higher mean rank received higher scores from research participants.

	Group	N	Mean Rank	Sum of Ranks
Website is simple to use	ParallaxScrolling	43	42.15	1812.50
	NonparallaxScrolling	43	44.85	1928.50
	Total	86		
Downloading pages is quick	ParallaxScrolling	43	44.55	1915.50
	NonparallaxScrolling	43	42.45	1825.50
	Total	86		
Content is easy to understand	ParallaxScrolling	43	42.94	1846.50
	NonparallaxScrolling	43	44.06	1894.50
	Total	86		

4.3.2 Enjoyment

The results returned from the Mann-Whitney test indicated that the two website versions did not differ significantly with respect to overall user enjoyment. Table 4.3 lists the items from the survey measuring this variable.

Table 4.4

Items measuring website enjoyment

Q4. This website is pleasant to use
Q5. I liked using this website
Q6. I found using this website to be enjoyable

With reference to Q4, website 1 ($Mdn = 6$), was preferred slightly more than website 2 ($Mdn = 5$). However this difference between the two websites was not significant, $U = 881$, $p = .68$, $r = -.04$. Participants also seemed to like website 1 ($Mdn = 5$) a bit more than website 2, ($Mdn = 5$). Once again, the Mann-Whitney test failed to return any significant differences between the two websites, $U = 829$, $p = .37$, $r = -.1$. With respect to Q6, users' seemed to have enjoyed website 1 (mean rank: 46.37) more than they did website 2 (mean rank: 40.63). However the user responses between the two groups did not significantly differ ($Mdn = 5$), $U = 801$, $p = .25$, $r = -.12$. Therefore the hypothesis that parallax scrolling will improve perceived enjoyment was rejected. The SPSS output of the Mann-Whitney test statistic and mean rank scores are reported below in Tables 4.5 and 4.6.

Table 4.5

Results of the Mann-Whitney test statistic with respect to hypothesis 2

	The website is pleasant to use	I liked using this website	This website is enjoyable
Mann-Whitney U	881.000	829.000	801.000
Wilcoxon W	1827.000	1775.000	1747.000
Z	-.411	-.890	-1.155
Asymp. Sig. (2-tailed)	.681	.373	.248

a. Grouping Variable: Group

Table 4.6

Mean rank scores for groups 1 and 2. The group with the higher mean rank received higher scores from research participants.

	Group	N	Mean Rank	Sum of Ranks
This website is pleasant to use	ParallaxScrolling	43	44.51	1914.00
	NonparallaxScrolling	43	42.49	1827.00
	Total	86		
I liked using this website	ParallaxScrolling	43	45.72	1966.00
	NonparallaxScrolling	43	41.28	1775.00
	Total	86		
This website is enjoyable	ParallaxScrolling	43	46.37	1994.00
	NonparallaxScrolling	43	40.63	1747.00
	Total	86		

4.3.3 Fun

Hypothesis 3 predicted that users would have more fun interacting with website 1. The Mann-Whitney test revealed a significant difference in the amount of fun users had interacting with website 1 relative to website 2. Table 4.7 lists the items measuring this dependent variable (fun).

Table 4.7

Items measuring how much fun users had interacting with the website

Q7. This website is interesting
Q8. Using the website was exciting
Q9. I had fun interacting with this website

Parallax scrolling significantly affected how interesting user believed website 1 was ($Mdn = 6$), compared to website 2 ($Mdn = 5$), $U = 557$, $p = .001$, $r = -.37$. With regard to Q8, the Mann-Whitney test also returned significant differences between group 1 ($Mdn = 5$) and group 2 ($Mdn = 5$), $U = 592$, $p = .003$, $r = -.32$. The analysis also showed medium sized effects for both items, confirming that the differences between the groups were substantial. With respect to Q9, users had significantly more fun interacting with website 1 ($Mdn = 5$) than they did with website 2 ($Mdn = 5$), $U = 701$, $p = .043$, $r = -.22$. However the effect size was smaller (.22), indicating that the difference between the groups was not as substantial as Q8 and Q9. Table 4.9 reports the mean scores from the two groups and it reveals a significant difference in the scores entered by the two groups. All three items returned significant results, thereby supporting the hypothesis that parallax scrolling is more fun. Table 4.8 below provides the SPSS output of the Mann-Whitney test for these three items.

Table 4.8

Results of the Mann-Whitney test statistic with respect to hypothesis 3

	Website was interesting	Website was exciting	I had fun interacting with this website
Mann-Whitney U	557.000	592.500	701.000
Wilcoxon W	1503.000	1538.500	1647.000
Z	-3.442	-3.007	-2.023
Asymp. Sig. (2-tailed)	.001	.003	.043

a. Grouping Variable: Group

Table 4.9

Mean rank scores for groups 1 and 2. The group with the higher mean rank received higher scores from research participants.

	Group	N	Mean Rank	Sum of Ranks
Website was interesting	ParallaxScrolling	43	52.05	2238.00
	NonparallaxScrolling	43	34.95	1503.00
	Total	86		
Website was exciting	ParallaxScrolling	43	51.22	2202.50
	NonparallaxScrolling	43	35.78	1538.50
	Total	86		
I had fun interacting with this website	ParallaxScrolling	43	48.70	2094.00
	NonparallaxScrolling	43	38.30	1647.00
	Total	86		

4.3.4 Satisfaction

Table 4.10

Items measuring website satisfaction

Q10. I am satisfied with my performance on this website

Q11. This website satisfies my particular needs well

Q12. The experience that I have had with this website has been satisfactory

The results of the Mann-Whitney test for the items in Table 4.10 were as follows and in the respective orders: $U = 896, p=.8, r = -.02$; $U = 917.5, p=.95, r = -.006$; $U = 915.5, p=.94, r = -.008$. The results returned no statistically significant differences between the two groups. Among the variables and hypotheses tested, the Mann-Whitney test reported the least differences between the groups with respect to user satisfaction.

Two of the items (Q11, Q12) returned a mean rank difference that was less than .5 confirming that users' responses were particularly similar. Table 4.12 provides a detailed report of this information. The effect sizes were also relatively small (-.02, -.006, -.008) providing further evidence that a difference did not exist between the groups. Consequently the hypothesis that parallax scrolling would improve user satisfaction was rejected. The results of the Mann-Whitney test statistic on the items measuring satisfaction can be found in Table 4.11.

Table 4.11.

Results of the Mann-Whitney test statistic with respect to hypothesis 4

	Satisfied with my performance	Satisfies my particular needs	Website has been satisfactory
Mann-Whitney U	896.000	917.500	915.500
Wilcoxon W	1842.000	1863.500	1861.500
Z	-.259	-.064	-.082
Asymp. Sig. (2-tailed)	.796	.949	.935

a. Grouping Variable: Group

Table 4.12.

Mean rank scores for groups 1 and 2. The group with the higher mean rank received higher scores from research participants.

	Group	N	Mean Rank	Sum of Ranks
Satisfied with my performance	ParallaxScrolling	43	42.84	1842.00
	NonparallaxScrolling	43	44.16	1899.00
	Total	86		
Satisfies my particular needs	ParallaxScrolling	43	43.66	1877.50
	NonparallaxScrolling	43	43.34	1863.50
	Total	86		
Website has been satisfactory	ParallaxScrolling	43	43.71	1879.50
	NonparallaxScrolling	43	43.29	1861.50
	Total	86		

4.3.5 Visual appeal

Hypotheses 5 proposed that parallax scrolling would create greater visual appeal. Questions 13, 14 and 15 which are listed in Table 4.13 were used to test this hypothesis.

Table 4.13

Items measuring website visual appeal

Q13. The screen design (ie, colors, boxes, navigation bars, etc) is attractive

Q14. The site looks professionally designed

Q15. The overall look and feel of the site is visually appealing

With respect to Q13, the Mann-Whitney test did not return any significant differences between group 1 ($Mdn=6$) and group 2 ($Mdn=6$), $U = 836$, $p=.39$, $r = -.09$. Users however thought website 1 (mean rank: 45.56) was slightly more attractive than website 2 (mean rank: 41.44) as defined by the differences in their mean rank scores.

On the other hand, the Mann-Whitney test returned statistically significant differences in participants perception of the professional design of the websites, $U = 633$, $p=.005$, $r = -.31$. Participants believed that website 1 ($Mdn =6$) looked more professionally designed than website 2 ($Mdn =5$). The effect size ($-.31$) and the mean rank difference (13.26) was also moderately large, confirming that the differences in users' opinions were significant. Table 4.15 reports the mean rank between the two groups.

With respect to the visual appeal of the two websites (Q15), users responses between website 1 ($Mdn=6$) and website 2 ($Mdn=5$) did not significantly differ, $U =$

759.5, $p=.11$, $r = -.17$. However the differences were noticeable. Group 1 reported a mean rank score of 47.34 while group 2 a mean rank of 39.66; a mean rank difference of 7.68. Although it is not significant, it does show that participants believed that website 1 was more visually appealing than website two. The results of the Mann-Whitney test statistic on the items measuring satisfaction can be found in Table 4.14.

Table 4.14

Results of the Mann-Whitney test statistic with respect to hypothesis 5

	Screen design is attractive	Website is professionally designed	Look and feel is visually appealing
Mann-Whitney U	836.000	633.000	759.500
Wilcoxon W	1782.000	1579.000	1705.500
Z	-.863	-2.833	-1.581
Asymp. Sig. (2-tailed)	.388	.005	.114

a. Grouping Variable: Group

Table 4.15

Mean rank scores for groups 1 and 2. The group with the higher mean rank received higher scores from research participants.

	Group	N	Mean Rank	Sum of Ranks
Screen design is attractive	ParallaxScrolling	43	45.56	1959.00
	NonparallaxScrolling	43	41.44	1782.00
	Total	86		
Website is professionally designed	ParallaxScrolling	43	50.28	2162.00
	NonparallaxScrolling	43	36.72	1579.00
	Total	86		
Look and feel is visually appealing	ParallaxScrolling	43	47.34	2035.50
	NonparallaxScrolling	43	39.66	1705.50
	Total	86		

While participants differed significantly in their opinions of the professional design of the website, the questions directly related to the visual appeal of the website did not return any significant results. In essence the participants from both groups believed the website to be equally attractive and as a result hypothesis 5 was rejected.

4.3.6 User experience and preference

Hypotheses 6 and 7 predicted that parallax scrolling would improve user experience and positively influence user preference. However, since a pleasurable user experience is dependent on website usability, enjoyment, fun, satisfaction, and visual appeal (Hassenzahl & Tractinsky, 2006; Norman, 2004), the other five hypotheses in this experiment would need to be true if these two hypotheses were to be supported. However four of those five hypotheses were rejected. Therefore hypothesis 6 and 7 were rejected. There was not sufficient evidence to show that parallax scrolling in a website will improve user experience and preference.

4.3.7 Summary

It was hypothesized that parallax scrolling would improve user experience and influence user preference. However the acceptance or rejection of these hypotheses depended on whether parallax scrolling improved perceived usability, enjoyment, fun, satisfaction, and visual appeal. These five variables have been claimed to directly affect overall user experience. With the exception of ‘fun’, the Mann-Whitney test failed to return any significant differences between the two experimental groups with respect to

these variables. Therefore the hypothesis that parallax scrolling improves user experience and preference was rejected.

CHAPTER 5. DISCUSSION

The objective of this research experiment was to analyze the effects of parallax scrolling on overall user experience. Seven hypotheses were made with the expectation that this upcoming web design practice would improve user experience and consequently user acceptance and preference of a website. However, the results of this research experiment clearly revealed that this is not the case.

Hypothesis 1 predicted that users would perceive website 1 (website using parallax scrolling effect) as more usable. This assumption was made based on the results of previous studies claiming that there is a strong correlation between the visual appeal of an interface and its perceived usability (Kurosu & Kashimura 1995; Tractinsky, 1997; Tractinsky, Katz, & Ikar, 2000). Questions 1, 2, and 3 of the survey were designed to test this hypothesis; however users' responses in regard to these items did not differ significantly between the two groups. Although this was not significant, group 2 (no parallax scrolling) reported a higher mean rank than group 1 (parallax scrolling), suggesting that website 2 was simpler to use. This may be attributed to the fact that many of the participants had not had any experience with parallax scrolling in a website prior to this experience. This result is consistent with the claim that the apparent usability of a product is a function of the user's expertise (Mugge & Schoormans, 2012).

The results showed no significant differences in the loading times of the two websites. This might be negligent because both websites were relatively small, but when loading a larger website containing multiple pages with hundreds of images, the difference in page load times will differ considerably. This time difference results because all elements in a website using parallax scrolling are loaded at startup, whereas a typical website stores elements on multiple pages, thus dramatically decreasing page load time.

This study also failed to produce significant results in support of hypothesis 2, that website 1 was more enjoyable. Although it was not significant, website 1 had a slightly higher mean rank score which means that group 1 had more high score responses. To some extent, this supports the claim that we acquire greater pleasure from interacting with novel objects (Berlyne, 1974; Biederman & Vessel, 2006). Since the parallax scrolling effect was novel to most people, they seemed to have experienced a greater enjoyment from it.

Overall the findings of this research experiment did not support hypothesis 2. Users demonstrated a high acceptance towards website 1, but it did not significantly differ from the enjoyment the users from group 2 received from their interaction with website 2. Thus it can be argued that parallax scrolling does not offer any additional benefits to web design considering that it is equally enjoyable, but may yet require longer loading times.

The third hypothesis predicted that parallax scrolling would result in more fun and the results fully supported this hypothesis. Users who interacted with website 1 had significantly more fun than those who used website 2. This is in line with previous

research showing that people exhibit more positive responses to novel products (Berlyne, 1974; Biederman & Vessel, 2006; Radford & Bloch, 2011). It also supports the fact that we are playful by nature and find amusement in things which satisfy this need (Kuts, 2009). The effect size also confirms a practical difference.

This result however seems inconsistent with hypothesis 2, considering that user enjoyment was not significantly different between the two websites. Research has shown fun to be highly correlated with enjoyment, playfulness and excitement (Chao, 2001; Shneiderman, 2004), yet the results returned no significant differences for enjoyment while at the same time returning significant results for fun. One would expect a fun interface to be more enjoyable, yet this experiment shows otherwise. Of special note however is the fact that although the level of enjoyment between the two groups was not statistically significant, the report did show a noticeable difference between the mean rank scores of the two groups. With respect to enjoyment, the report showed a mean rank difference of 6 while most of the other none significant variables averaged a mean rank difference between 1 and 2. This shows that ‘enjoyment’ on average received a greater number of high scores than the other variables.

This study provided the least evidence to support hypothesis 4, that parallax scrolling would improve user satisfaction. With respect to this hypothesis, the results from the two groups were most similar. A possible explanation for such comparable results could be attributed to the fact that users had not come to the website with a specific purpose, and thus may not have been task oriented.

Hypothesis 5 proposed that website 1 would be perceived as more aesthetically pleasing than website 2. The results did not prove significant in this regard. Two of the

items used to test this hypothesis focused primarily on the visual appeal of the website while the other focused more on professional design. There were no significant differences in visual appeal between the two websites, however users thought website 1 was designed more professionally than website 2. This harmonizes with the findings of previous research (Lavie & Tractinsky, 2004) who claimed that aesthetics is divided in two dimensions; classical and expressive. Evidently while both websites reflected good levels of classical aesthetic (clearness, cleanness of the website, symmetrical design, ect), website 1 had an added feature which showed creativity, novelty and originality, and that distinguished it from website 2.

In conclusion we rejected the hypothesis that parallax scrolling can improve overall user experience and preference; however this by no means negates the usefulness of parallax scrolling in web design. The study showed that parallax scrolling was more fun and it also gave the perception of a more professional design. This means that parallax scrolling can be tremendously useful in certain circumstances and that refers to its context of use. The ‘fun’ aspect of parallax scrolling means that the effect can serve a beneficial purpose in a website where the intention of the user is hedonic or play.

5.1 Limitations

This study might have been subjected to certain confounding factors that could have affected the results of the study. The study was conducted on a table in the lobby at Stewart Center, Purdue University and consequently the environment was not directly controlled by the researcher. Therefore users completed the experiment under different environmental conditions, sometimes quiet and sometimes more distracting, which may

have influenced their responses. However to control this, participants were not allowed to complete the experiment when it was too loud or distracting.

5.2 Conclusion

Parallax scrolling has become a very popular strategy in web design. Proponents of the technique regard it as a tool to grab the users' attention and engage them with a website. Designers consider the technique visually appealing, interesting and engaging, thus making it well suited to enhance the user experience.

The goal of this study was to investigate whether parallax scrolling improved user experience and preference in a website. Based on this experiment, parallax scrolling was found to significantly improve the amount of fun users have on a website as well as the professional design of the website. However, the website in this study utilizing the parallax scrolling effect was perceived to be just as usable, satisfying, enjoyable, and visually appealing as the website not utilizing the parallax effect. The results showed that although parallax scrolling did not improve overall user experience and preference, the effect can have substantial benefits within certain contexts.

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APPENDICES

Appendix A. IRB Approval Letter



HUMAN RESEARCH PROTECTION PROGRAM
INSTITUTIONAL REVIEW BOARDS

To:	JAMES MOHLER KNOY 347
From:	JEANNIE DICLEMENTI, Chair Social Science IRB
Date:	03/04/2013
Committee Action:	Approval
IRB Action Date	03/04/2013
IRB Protocol #	1302013319
Study Title	The Effects of Parallax Scrolling on User Experience and Preference
Expiration Date	03/03/2014

Following review by the Institutional Review Board (IRB), the above-referenced protocol has been approved. This approval permits you to recruit subjects up to the number indicated on the application form and to conduct the research as it is approved. The IRB-stamped and dated consent, assent, and/or information form(s) approved for this protocol are enclosed. Please make copies from these document(s) both for subjects to sign should they choose to enroll in your study and for subjects to keep for their records. Information forms should not be signed. Researchers should keep all consent/assent forms for a period no less than three (3) years following closure of the protocol.

Revisions/Amendments: If you wish to change any aspect of this study, please submit the requested changes to the IRB using the appropriate form. IRB approval must be obtained before implementing any changes unless the change is to remove an immediate hazard to subjects in which case the IRB should be immediately informed following the change.

Continuing Review: It is the Principal Investigator's responsibility to obtain continuing review and approval for this protocol prior to the expiration date noted above. Please allow sufficient time for continued review and approval. No research activity of any sort may continue beyond the expiration date. Failure to receive approval for continuation before the expiration date will result in the approval's expiration on the expiration date. Data collected following the expiration date is unapproved research and cannot be used for research purposes including reporting or publishing as research data.

Unanticipated Problems/Adverse Events: Researchers must report unanticipated problems and/or adverse events to the IRB. If the problem/adverse event is serious, or is expected but occurs with unexpected severity or frequency, or the problem/event is unanticipated, it must be reported to the IRB within 48 hours of learning of the event and a written report submitted within five (5) business days. All other problems/events should be reported at the time of Continuing Review.

We wish you good luck with your work. Please retain copy of this letter for your records.

Appendix B. Research Participant Consent Form

Research Project Number _____



RESEARCH PARTICIPANT CONSENT FORM

The Effects of Parallax Scrolling on User Experience and Preference

Purdue University

Computer Graphics Technology

Purpose of Research: Parallax scrolling has become a very popular technique in web design over the past few years. The parallax scrolling effect allows multiple backgrounds in a webpage to move simultaneously at different speeds to create a 3D perception, therefore creating a visually appealing and enriching the browsing experience. Research has revealed that a pleasurable user experience can create loyalty and determine the success of a product or technology and today many web designers acclaim parallax scrolling as the tool suited for enhancing the user experience. The purpose of this research is to find how novelty in web design affects preference and user experience. In this study we seek to investigate the effects of vertical parallax scrolling on subjective user experience and preference.

Specific Procedures:

1. Prior to starting the experiment, you will be presented a page containing instructions to guide you through the experiment.
2. Upon reading the instructions you will navigate to the web address that is provided to you at the end of the instructions page either by directly clicking the link or entering the provided URL in the address bar.
3. You will be asked to spend some time browsing the websites because you will have to complete a questionnaire that will require your subjective evaluation in respect to the website's visual appeal, usability, satisfaction, enjoyment and fun. Upon browsing the website you will complete two tasks.
4. The first task will ask you to complete a web form with your demographic information.
5. For the second task, you will be asked to find a particular product on the website and perform a purchasing task.
6. When the tasks are completed, you will answer a 'fifteen- item posttest survey to measure your overall experience with the website. All survey items will be measured on a 6-point Likert scale with "strongly disagree" (1) and "strongly agree" (6).

Research Project Number _____

7. Upon conclusion of the experiment, you will enter your email addresses in a text field where it will be saved to a database. The email address will not be linked with your completed experiment or the survey, but will be collected for contact purposes in the event that you win one of the gift cards.
8. You have to complete the experiment to be included in the draw for the gift cards. You will not be included in the raffle draw if you do not complete the experiment.

Venue of Research Study: We intend for you to complete the research study at the Purdue Memorial Union (PMU) or Stewart center. Two computers have been arranged on two tables in the hallway, where you will sit to complete the experiment.

Duration of Participation: The research study is expected to last at most 10 minutes.

Risks to the Individual:

This is a minimal risk study. The tasks that are asked of the participants can be considered as daily tasks done when surfing the internet. You can refuse or stop the study at any time if you feel uncomfortable. However you will not be included in the raffle draw if do not complete the experiment.

Benefits:

There are no direct benefits to you in this experiment.

If you are a web designer or own a personal website, then there may be potential benefits. This may include knowledge on website design techniques that may improve the user experience of your website.

Compensation: Participation in this experiment will qualify you to be entered in a raffle draw for three \$20.00 Walmart gift cards. You will receive an email notifying you of the time and venue of the draw. In the event that you win, an email will be sent to you notifying you of your prize. You have a 1 out of 40 chance of winning one of the gift cards in the draw; this is a 2.5% chance.

Confidentiality: You will not have to provide any private information besides your age, which is necessary to understand the sample population. Your name will not be associated with your

Research Project Number _____

responses. Instead you will be identified by a number. All data collected will be in an encrypted file only accessible by password. We will collect your email address, but this will not be linked with your responses. This is necessary to contact you in the event that you win one of the prizes. Your email information will be destroyed directly following the drawing.

The project's research records may be inspected by the Purdue University Institutional Review Board or its designees to ensure that your rights are being protected.

Voluntary Nature of Participation: You do not have to participate in this research project. If you agree to participate you can withdraw your participation at any time, but will not be eligible for the drawing of the gift cards.

Contact Information: James L. Mohler Ph.D. (Email: jlmohler@purdue.edu, Phone: 765.496.6071) is the Principal Investigator of the research. Questions concerning the research or follow up can be directed to Dede Frederick, dfreder@purdue.edu.

If you have concerns about your treatment or the treatment of other research you, you can contact the Institutional Review Board (IRB) at Purdue University, Ernest C. Young Hall, Room 1032, 155 S. Grant St., West Lafayette, IN 47907-2114. IRB's phone number is (765) 494-5942. The email address is irb@purdue.edu.

Documentation of Informed Consent

I have had the opportunity to read this consent form and have the research study explained. I have had the opportunity to ask questions about the research project and my questions have been answered. I am prepared to participate in the research project described above. I will receive a copy of this consent form after I sign it.

Your Signature

Date

Your Name

Researcher's Signature

Date

Appendix C. Research Survey

Click to write the question text

	Strongly Disagree					Strongly Agree
This website is simple to use, even when using it for the first time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Downloading pages from this website is quick	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The structure and contents of this website are easy to understand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

>>

	Strongly Disagree					Strongly Agree
This website is pleasant to use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I liked using this website	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found using this website to be enjoyable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

>>

	Strongly Disagree					Strongly Agree
This website is interesting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using the website was exciting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I had fun interacting with this website	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

>>

	Strongly Disagree					Strongly Agree
I am satisfied with my performance on this website	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This website satisfies my particular needs well	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The experience that I have had with this website has been satisfactory	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

>>

	Strongly Disagree					Strongly Agree
The screen design (ie, colors, boxes, navigation bars, etc) is attractive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The site looks professionally designed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The overall look and feel of the site is visually appealing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

>>

Appendix D. Participants Tasks

1. Prior to starting the experiment, you will be presented a sheet containing instructions to guide you through the experiment.
2. Upon reading the instructions you will navigate to the web address that is provided to you on the computer either by directly clicking the link or entering the provided URL in the address bar.
3. You will be asked to spend some time browsing the website. Upon browsing, you will complete two tasks.
4. The first task will ask you to complete a web form with your demographic information.
5. For the second task, you will be asked to make a reservation to the hotel through the website.
6. When the tasks are completed, you will answer a ‘fifteen- item posttest survey to measure your overall experience with the website. All survey items will be measured on a 6-point Likert scale ranging from “strongly disagree” (1) to “strongly agree” (6).
7. Upon conclusion of the experiment, you will enter your email addresses in a text field where it will be saved to a database. The email address will not be linked with your completed experiment or the survey responses, but will be collected for contact purposes in the event that you win one of the gift cards.